Space Weather Technical Forecast

Issued on Monday, 15 August 2022 at 13:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Ongoing Active electron fluence. G1/Minor storm likely on day 3 (17th). Chance of Moderate flares (R1-R2 Radio blackouts) throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the past 24 hours, with occasional C-class flares. The largest of these was a C5.3 at 14/1400 UTC from AR3079 (Dai/beta) in the southwest quadrant. AR3081 (Dai/Beta) is of similar size and complexity, but has remained stable during this period. AR3078 (Dki/Beta-Gamma-Delta) in the south central disc has undergone the greatest development over the past 24 hours, developing a large penumbra that includes a delta spot. It was this region that was the source for a small coronal mass ejection (CME) around 13/1700 UTC that has been analysed to pass just to the south of Earth on day 3 (17th). Another region of note is AR3076 (Cao/Beta-gamma) in the northwest. This was responsible for a long duration C flare that started at 14/1200 UTC and emitted a CME towards Earth, with an expected impact on the 17th. Another CME occurred from a filament eruption in southwest quadrant at around 15/0500 UTC. There is the potential for this to have an Earth directed component but will require further analysis once imagery becomes available. The remaining region on the disc is AR3074 (Hsx/Alpha) in the southwest quadrant, this remains small and stable.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, is showing a slightly elevated wind environment, with speeds 450-500km/s. Density remained at average levels with a slowly declining trend (5-8nT). The IMF was weak throughout with the north-south component varying weakly (+/- 5nT). The phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at Background levels. The high energy electron flux (greater than 2 MeV) was High, with a peak of 3.19e3 pfu at 15/1145 UTC. The 24-hour integrated electron fluence was above Active threshold throughout, with an observed value of 1.21e8 integrated pfu at 15/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain predominantly Low, although there is a chance (40%) of it increasing to Moderate at times, with isolated M-class flares.

Solar Wind / Geomagnetic Activity: Solar winds are expected to be close to ambient levels on days 1 and 2 (15th and 16th). On day 3 (17th), Earth is expected to connect with the high speed stream from coronal hole 14. This enhancement is likely to be further enhanced by a CME, which is forecast to impact Earth around the same time frame. Geomagnetic activity is expected to be mainly Quiet, with isolated Unsettled intervals through the next two days. On day 3 (17th), activity is expected to become Unsettled to Active, and a G1/Minor Storm interval is likely. There is also a slight chance of a G2/Moderate Storm in association with the CME arrival.

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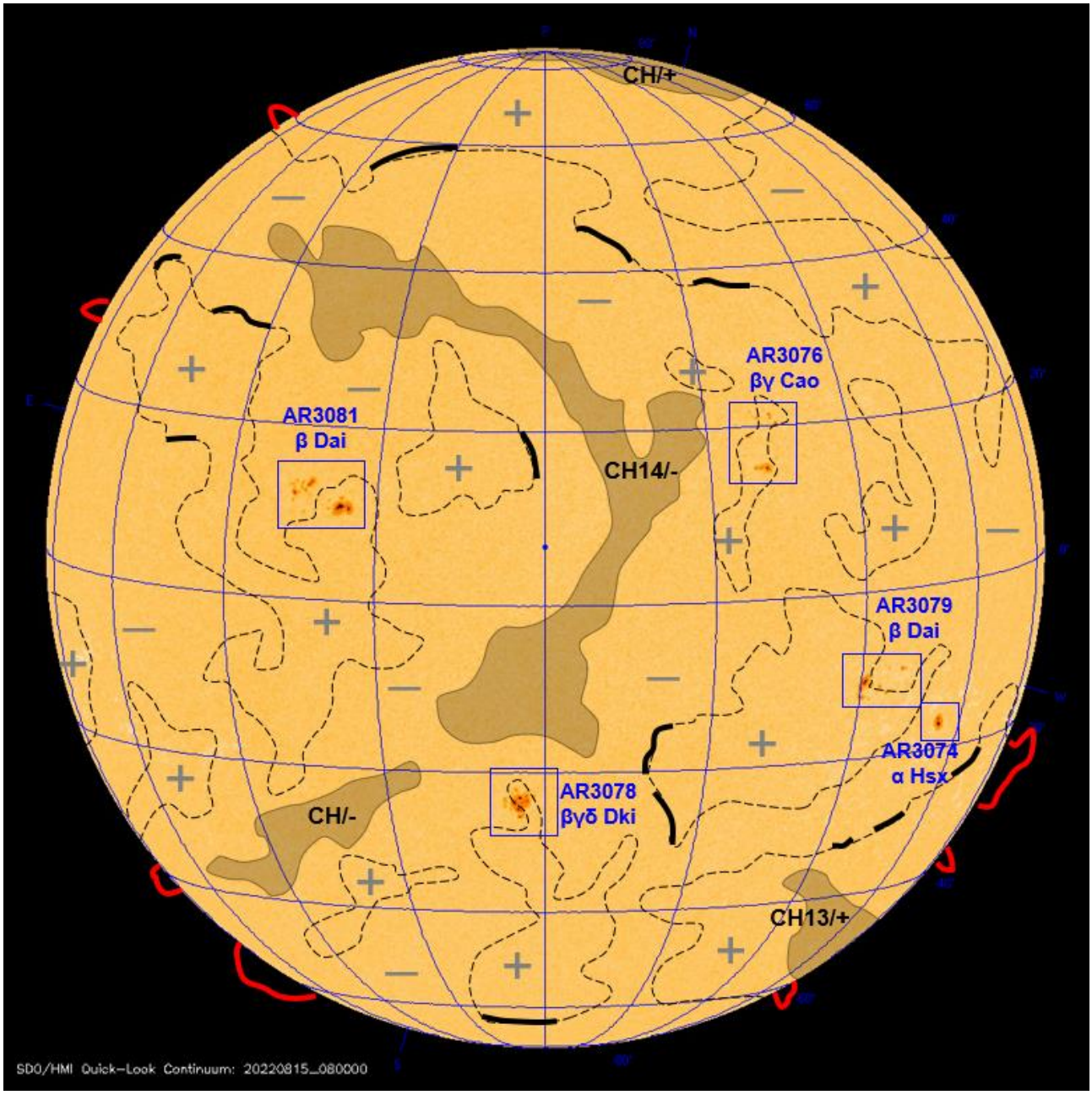
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels, although with a slight chance of an S1 or greater event. High energy electron flux is expected to continue at a moderate to High (1e3 pfu) levels through days 1 and 2 (15th/16th) before becoming suppressed on day 3 (17th). Electron fluence values are forecast to remain above the Active threshold through days 1 and 2 (16th and 17th), bur during day 3 (17th) fluence values are expected to drop below the Active threshold and are likely to remain below for the rest of the period.

Figure 1. Solar Analysis Valid 15/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds are expected to be close to ambient levels on days 1 and 2 (15th and 16th). On day 3 (17th) Earth is expected to connect with the high speed stream from coronal hole 14, as it moves into a geoeffective position. This coronal hole is a recurrent feature and thus wind speeds are likely to be similar to previous rotation, becoming elevated to around 500-600km/s. This enhancement is likely to be further enhanced by a CME, which is forecast to impact Earth around the same time frame. Along with this there is a chance of further enhancement due to embedded CME effects, from a second CME which left the Sun on the 13th, and this will most likely pass to the south of Earth. However, there is a possibility of a glancing blow, and if this was to occur it could coincide with first CME and the coronal hole enhancement on the 17th.
Geomagnetic activity is expected to be mainly Quiet, with isolated Unsettled intervals through the next two days. On day 3 (17th), activity is expected to become Unsettled to Active, and a G1/Minor Storm interval is likely. There is also a slight chance of a G2/Moderate Storm, most likely when the CME(s) mentioned above impact Earth.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	10	60	30
Strong	G3	No	1	1	20	5
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
14/1747	Partial Halo	AR3076	NW quadrant	620	17/0600 UTC	Dawn out C-class flare that was accompanied by Type II emission

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Radio Blackouts - X-Ray Flares:

Solar activity is currently Low, with occasional C-class flares. Activity will most likely remain Low, with further C-class flares expected. However, there is a chance (40%) of it increasing to Moderate at times, with isolated M-class flares. There is also a slight chance (5%) of an X-class flare. The most complex region and most likely source of this activity is AR3078 (Dki/Beta-Gamma-Delta) in the southern central disc. There are 3 other noteworthy regions on the disc: AR3076 , AR3079 and AR3081 which are also moderately large and raise the flare risk, but are currently less complex.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and is likely to remain at this level through the period. Both AR3076 and AR3079 have a very slight risk of proton events and are now in the western hemisphere. This risk increases slightly through the period as AR3078 and AR3081 also progress into the western hemisphere.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	5	10	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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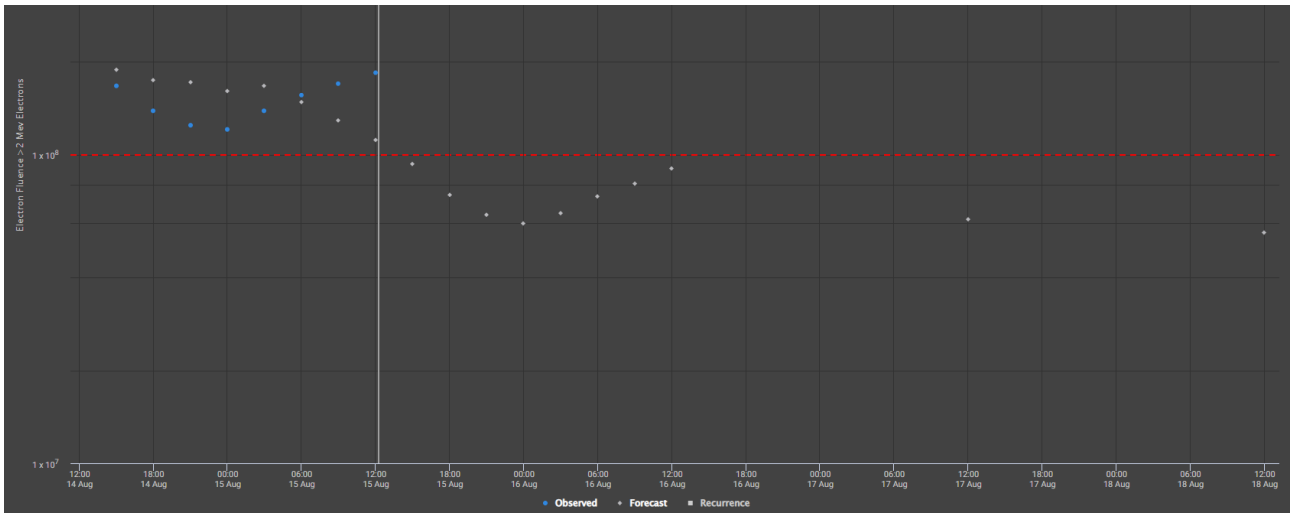
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) is expected to continue to diurnally fluctuate between moderate and high levels throughout the next two days. On day 3 (17th), electrons are expected to become suppressed due to the expected increase in geomagnetic activity associated with the arrival of the coronal hole enhancement and the CME(s). A rise towards the High threshold is likely once again later on day 4 (18th) as geomagnetic activity begins to subside.
Electron fluence values are expected to remain above the Active threshold through days 1 and 2 (16th and 17th), with REFMs guidance thought to be slightly too low. During day 3 (17th) fluence values are expected to drop below the Active threshold and are likely to remain below for the rest of the period.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	80	60	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 2: GOES 16 observed electron fluence and REFM data.



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